Vascular Cerebral Anomalies Associated with Septo-Optic Dysplasia
A Case Report

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SUMMARY – *We describe a case of Septo-Optic Dysplasia (SOD) characterized by the presence of anomalous cerebral vessels. In our young patient the classical features of SOD were associated with vascular anomalies including absence of the vein of Galen, right Rosenthal vein leading to the superior petrosal sinus, and anomalous origin of the anterior choroidal arteries. These findings have never been associated with SOD in the literature but their revelation supports the hypothesis of a vascular disruption as a possible cause of the SOD.*

Introduction

Septo-optic dysplasia is a rare congenital syndrome characterized by different combinations of defects in midline brain structures.

The most common features in SOD are hypoplasia or absence of the septum pellucidum, hypoplasia or dysplasia of optic nerves, pituitary or hypothalamic dysfunction [1]. However only 30% of cases present the complete triad [2] and almost 40% of SOD patients may present with normal endocrinology [3].

We describe MRI and CT findings in a patient with SOD characterized by vascular abnormalities, emphasizing the correlation between SOD and a vascular disruption that may occur during embryologic development.

Case Report

A 19-year-old female, the daughter of consanguineous parents (first-degree cousins), with a clinical history of SOD and retardation, arrived at the emergency department of our hospital because of mild body temperature increase (T= 37°C) associated with persistent vomiting and soporous state. She was transferred to the internal medicine department where neurological examination revealed weakness with decreased muscular tone of the lower limbs, inability to sustain an upright posture and, subsequently, also difficulty maintaining the sitting posture. The patient was admitted to our neuroradiology department and underwent MRI evaluation of brain and of the cervicothoracic spine.

MRI brain examination was performed using a 1.5 T MR unit in axial, coronal and sagittal planes with FSE T1- and T2-weighted sequences, FLAIR, DWI, and T1 3D FSPGR sequences before and after intravenous injection of gadolinium.

MRI examination of the cervicothoracic spine was performed using a 1.5 T MR unit in sagittal planes with FSE T1- and T2-weighted sequences, and FSE T1 sequences after intravenous injection of gadolinium.

In addition to known midline brain malformations characteristic of SOD (enlargement of the lateral ventricles which appeared dysmorphic and fused because of septum pellucidum agenesis, thinning of the corpus callosum and neurohypophysis agenesis, hypoplasia of the adenohypophysis and of the optic chiasm (Figures 1-3), MRI imaging revealed numerous diffuse lesions of the periventricular and

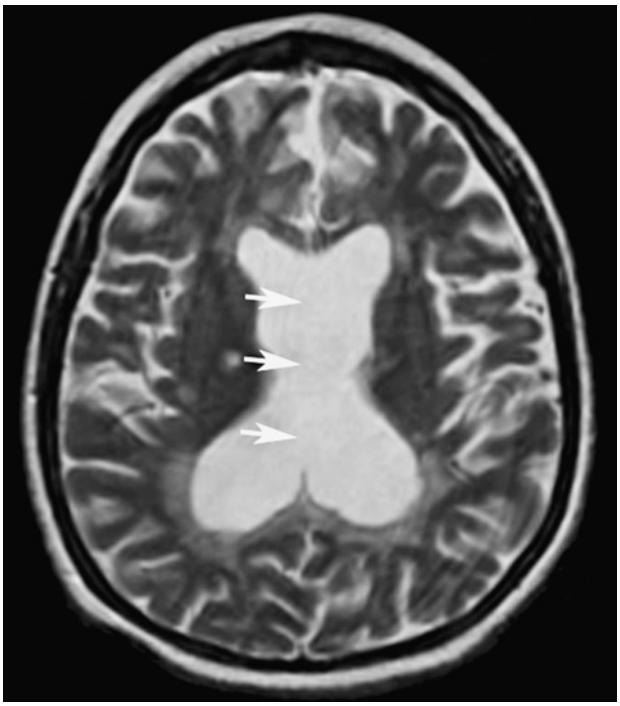

Figure 1 MRI T2-weighted axial image revealing absence of the septum pellucidum (arrows) and enlargement of the lateral ventricles which appear dysmorphic and fused.

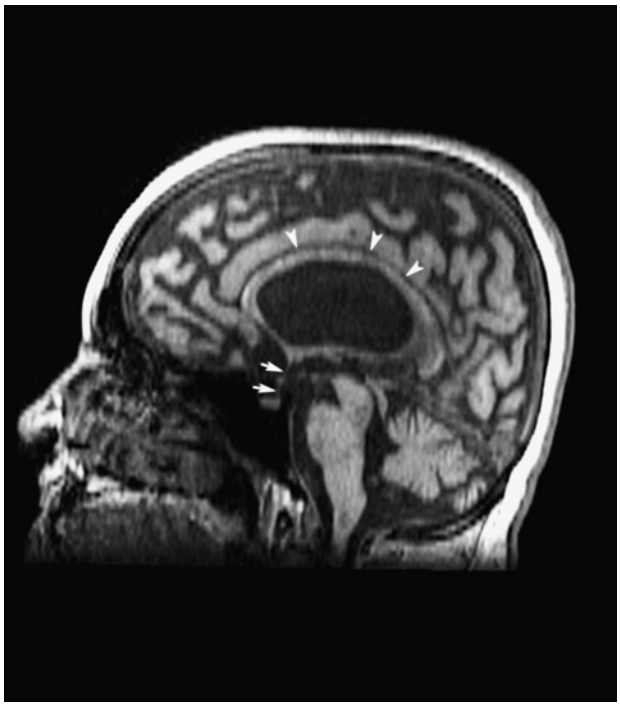

Figure 2 MRI T1 3D FSPGR sagittal image revealing thinning of the corpus callosum (arrowheads) and pituitary stalk hypoplasia (arrows).

cerebellar white matter (Figure 4), in the corpus callosum and in the cervicothoracic spine. These lesions presented both edemigenous and demyelinating aspects and, after intravenous injection of gadolinium, showed a pronounced contrast enhancement. On diffusion-weighted sequences these areas, especially those in the periventricular white matter, showed an altered signal due to reduced diffusion. These features are compatible with acute disseminated encephalomyelitis. Contrastographic sequences also revealed arterial and venous vascular anomalies, which led us to perform a CT study of the brain using an iodinated contrast agent.

CT study was performed with the spiral technique followed by multiplanar reconstructions using a 64-slice multidetector CT scanner after intravenous injection of an iodinated contrast agent.

CT scans and following reformations confirmed the vascular anomalies. We found a hypoplastic A1 segment of the right anterior cerebral artery and observed that the left posterior cerebral artery gave rise to a branch leading to the ipsilateral crural cistern (Figure 5) and another branch running through the suprasellar cistern, just upon the sellar segment of the Liliequist membrane [4], and then apparently leading to the right crural cistern (Figure 6). We assume that this is an anatomical variation of the anterior choroidal arteries, never described before even in microsurgical dissections [5].

Venous anomalies included agenesis of the great cerebral vein (vein of Galen) with the two internal cerebral veins leading, after the ambient cistern, to the straight sinus which was shorter than usual (Figure 7). The inferior sagittal sinus led directly to the confluence of sinuses (torcular Herophili) (Figure 8). The right Rosenthal vein in the perimesencephalic tract led to the ipsilateral superior petrosal sinus.

Discussion

Septo-optic dysplasia (SOD) consists in a variable combination of defects of the midline brain structures. The most common features include optic nerve hypoplasia, which is generally the first manifestation of the syndrome, absence or hypoplasia of the septum pellucidum and of the corpus callosum, and pituitary hypoplasia.

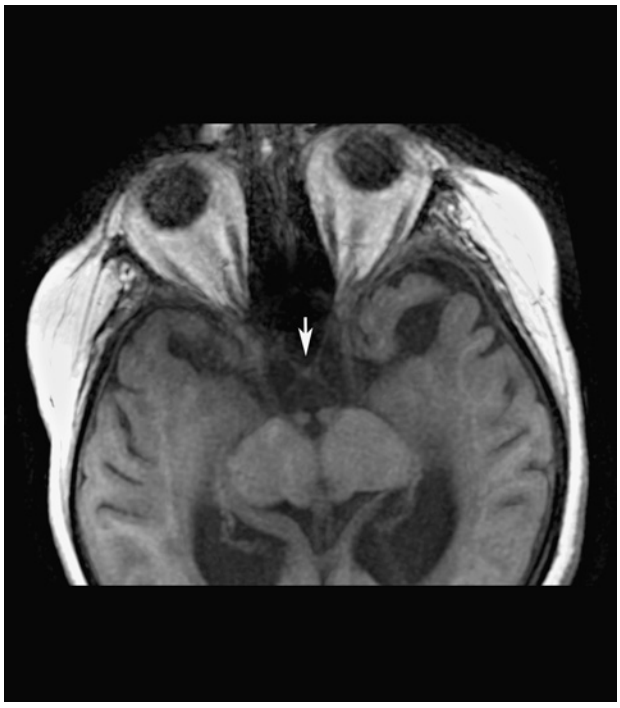

Figure 3 MRI T1 3D FSPGR axial image showing hypoplasia of the optic chiasm (arrow).

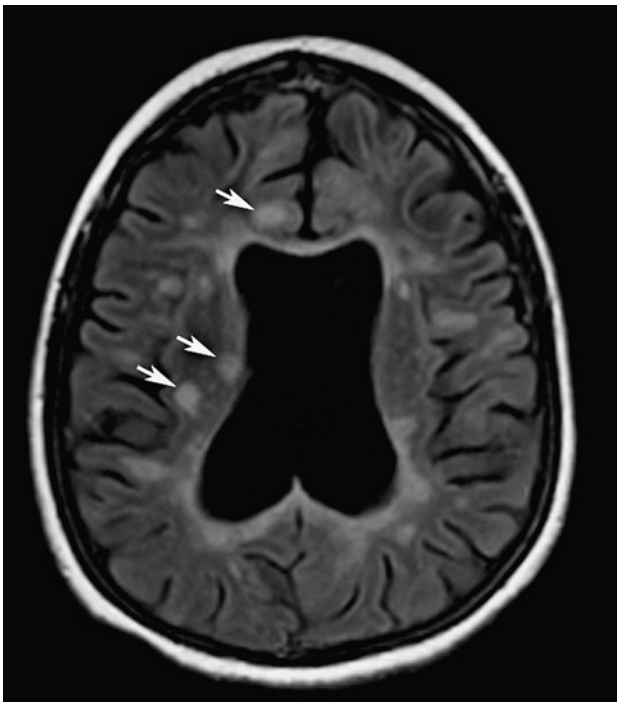

Figure 4 MRI FLAIR axial image revealing numerous diffuse demyelinating lesions of the periventricular white matter (arrows).

SOD is generally a sporadic syndrome, but rare familiar cases have also been described, suggesting a genetic etiology. The syndrome is reported to be more common in children born to younger primigravida mothers (mean age 22 years) [6]. Even if the sporadic occurrence of SOD remains unexplained, it has been suggested that SOD is the end result of several different genetic abnormalities or *in utero* injuries, such as vascular disruption [7], viral infections [8] or maternal exposure to valproic acid [9].

Optic nerve hypoplasia is usually bilateral (88% of the cases) rather than unilateral and is often the first clinical presentation while endocrinological abnormalities may manifest later [10]. In rare cases, eye abnormalities may be severe, including microphthalmia or bilateral anophthalmia [8].

Pituitary dysfunction may be extremely variable ranging from isolated growth hormone deficiency to panhypopituitarism [11]. Neuroimaging may predict the occurrence of hypopituitarism if hypoplasia of the anterior pituitary gland or an undescended posterior hypophysis or an absent pituitary stalk are found because these morphological features can predict hypopituitarism [12].

Midline anomalies also include a wide phenotype spectrum, ranging from the absence of the septum pellucidum to the agenesis/hypoplasia of the corpus callosum and fornix.

Sometimes cortical abnormalities can also be present, such as schizencephaly and cortical dysplasia [13]. Indeed Barkovich divided septo-optic dysplasia patients into two groups according to embryogenesis and MRI findings: one group included patients with associated schizencephaly, normal ventricles and normal appearance of optic radiations; the other did not manifest schizencephaly but had diffuse white matter hypoplasia and complete absence of the septum pellucidum [1].

Other associated anomalies may be cavum septum pellucidum, cerebellar hypoplasia and encephalocele [14].

Dysmorphic abnormalities may also involve facial midline structures, for example frontal bossing, hypertelorism or depressed nasal bridge; other segment of the body may also be involved including skull, musculo-skeletal system and genitalia [15].

To date the certain etiology of SOD remains unknown; the only plausible hypothesis being vascular disruption. In fact, all the cerebral

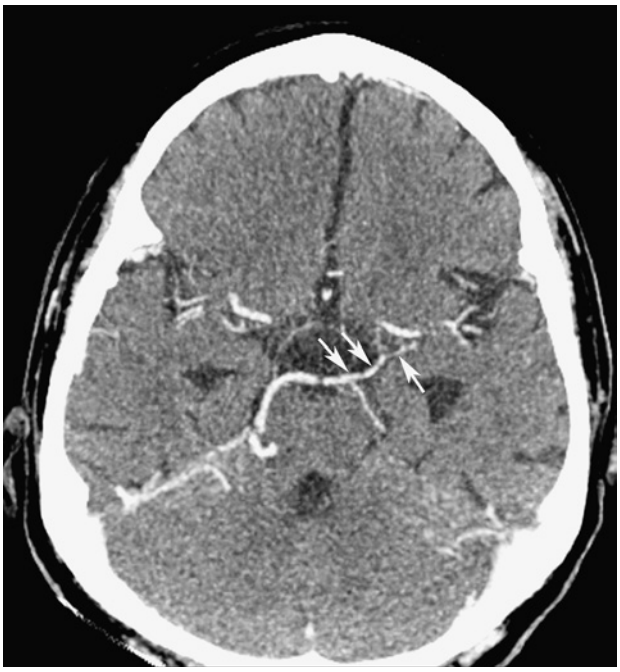

Figure 5 CT axial MIP reconstruction showing the branch of the left posterior cerebral artery leading to the ipsilateral crural cistern (arrows)

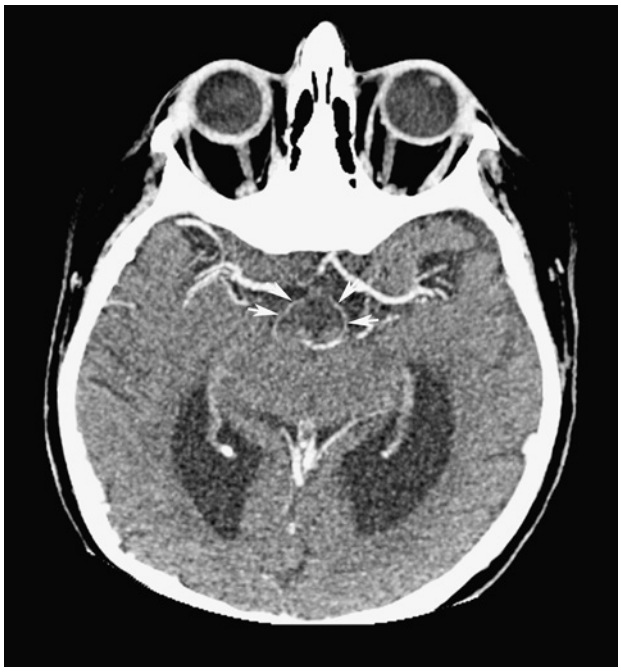

Figure 6 CT axial MIP reconstruction showing another left posterior cerebral artery branch running through the suprasellar cistern, just upon the sellar segment of the Liliequist membrane.

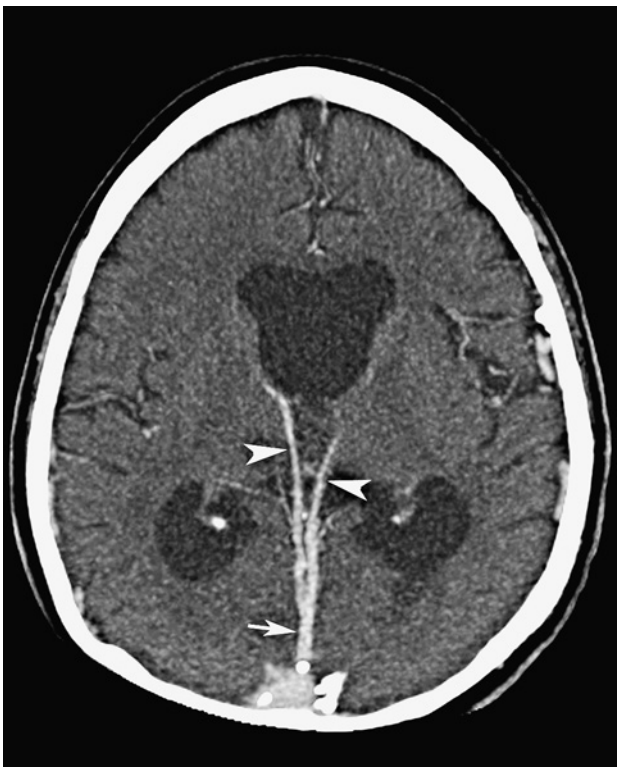

Figure 7 CT axial MIP reconstruction revealing agenesis of the great cerebral vein (vein of Galen) with the two internal cerebral veins (arrowheads) leading, after the ambient cistern, to the straight sinus (arrow) which is shorter than usual.

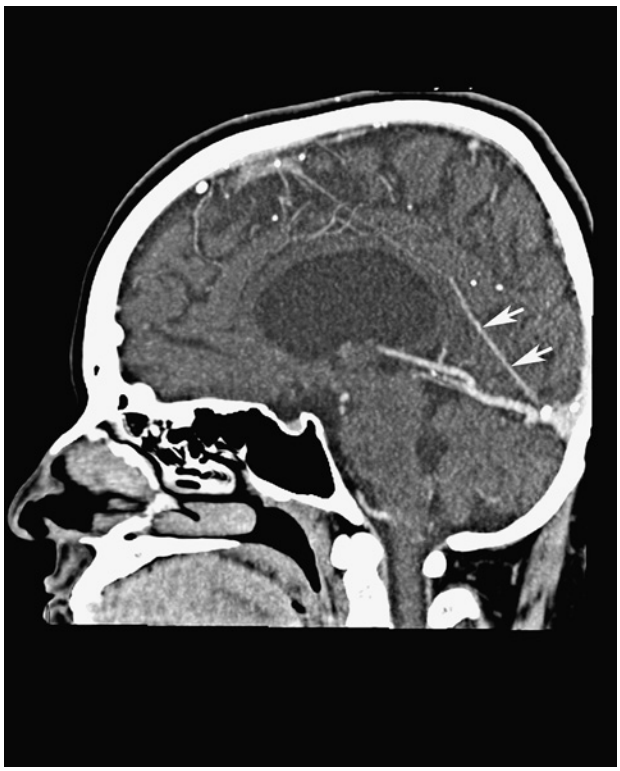

Figure 8 CT sagittal MIP reconstruction demonstrates the inferior sagittal sinus (arrows) leading directly to the confluence of sinuses (torcular Herophili).

structures involved in SOD develop in different embryologic phases and have different embryologic origin. In addition, all components involved in SOD are vulnerable to vascular events. These assumptions suggest, according to Lubinsky's hypothesis, a vascular disruption sequence possibly involving the proximal trunk of the anterior cerebral artery, because the segment prior to the origin of the anterior communicating artery passes over the optic tract and chiasm giving rise to an inferior group of arteries that supply the superior surface of the optic nerve and chiasm and to a superior group that goes to the anterior hypothalamus, septum pellucidum and other structures.

In our opinion, this hypothesis may be extended to include not only the anterior cerebral artery but also other vessels originating from the circle of Willis and from the supraclinoid segment of the internal carotid. In fact this segment gives rise to the anterior choroidal artery and to perforating arteries supplying nervous structures located in the sellar and suprasellar regions (optic nerves, optic chiasm, optic tracts, mammillary bodies, anterior perforated substance). Our patient seems to present an anomalous origin of the left anterior choroidal artery from the ipsilateral posterior cerebral artery. This particular anatomical variation has never been described before: according to the literature, the anterior choroidal artery rarely presents an anomalous origin (1%) from the medial cerebral artery or from the posterior communicating artery [16].

Moreover, our patient presented venous abnormalities but an in-depth literature review failed to disclose anything on venous abnormalities associated with septo-optic dysplasia.

In conclusion, even if there are no literature studies on vascular abnormalities associated with septo-optic dysplasia, it would be useful to pay attention to any arterial and venous cerebral abnormalities in patients with SOD, because they may be a cause or one of the causes of this anomalous development of midline brain structures.

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